

What is claimed is:

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CLAIMS

1. A system for air embossing a surface of an embossable fabric comprising:
a cylindrical stencil having an inside surface and a fabric-facing surface; and
at least one stencil stabilizer constructed and positioned to apply a force to the stencil
5 during operation of the system sufficient to reduce variations in a distance separating the
embossable surface of the fabric and a portion of the fabric-facing surface of the stencil
directly adjacent thereto during rotation of the stencil.

2. The system of claim 1, wherein the at least one stencil stabilizer is constructed and
10 positioned to apply a force to the stencil during operation of the system that is sufficient to
essentially eliminate variations in a distance separating the embossable surface of the fabric
and a portion of the fabric-facing surface of the stencil directly adjacent thereto during
rotation of the stencil.

3. The system of claim 1, wherein the at least one stencil stabilizer is constructed and
15 positioned so that at least a portion thereof is in contact with a surface of the stencil.

4. The system of claim 3, wherein the at least one stencil stabilizer is constructed and
positioned so that at least a portion thereof is in essentially continuous contact with a surface
20 of the stencil during the entirety of its rotation.

5. The system of claim 3, wherein the force applied to the stencil by the at least one
stencil stabilizer is sufficient to create a tension in the stencil.

6. The system of claim 5, wherein the force applied to the stencil by the at least one
25 stencil stabilizer is sufficient to distort the shape of the stencil during a least a portion of the
rotation of the stencil.

7. The system of claim 3, wherein at least a portion of the stencil stabilizer contacts an
30 inner surface of the stencil.

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8. The system of claim 7, further comprising an air lance including at least one nozzle thereon, the nozzle being constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric.

5 9. The system of claim 8, wherein no portion of the stencil stabilizer intercepts a stream of air emitted from the nozzle during rotation of the stencil.

10. The system of claim 9, wherein the stencil stabilizer does not rotate during rotation of the stencil.

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11. The system of claim 10, wherein the stencil stabilizer is connected to the air lance.

12. The system of claim 11, wherein the stencil stabilizer comprises at least a portion of a nozzle forming component of the air lance.

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13. The system of claim 11, wherein at least a portion of the stencil stabilizer is positioned at a zero separation distance in contact with the inner surface of the stencil and wherein a distance separating the nozzle from the inner surface of the stencil is equal to or exceeds the zero separation distance.

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14. The system of claim 13, wherein the distance separating the nozzle from the inner surface of the stencil is adjustable.

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15. The system of claim 14, wherein the level of force applied to the inner surface of the stencil is inversely proportional to the distance separating the nozzle from the inner surface of the stencil.

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16. The system of claim 11, wherein at least a portion of the stencil stabilizer contacts the inner surface of the stencil at location that is upstream of the nozzle.

17. The system of claim 16, wherein the system includes at least two stencil stabilizers.

18. The system of claim 17, wherein at least a portion of a first stencil stabilizer contacts the inner surface of the stencil at location that is upstream of the nozzle and wherein at least a portion of a second stencil stabilizer contacts the inner surface of the stencil at location that is downstream of the nozzle.

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19. The system of claim 8, wherein a maximum first distance separating the embossable surface of the fabric from a portion of the fabric facing surface of the stencil directly adjacent thereto, without the force applied to the stencil by the stencil stabilizer, exceeds a maximum second distance separating the embossable surface of the fabric from the portion of the fabric facing surface of the stencil directly adjacent thereto when the system is configured for operation with the force applied to the stencil by the stencil stabilizer.

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20. The system of claim 19, wherein the first distance exceeds the second distance by at least about 0.001 inch.

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21. The system of claim 20, wherein the first distance exceeds the second distance by at least about 0.005 inch.

22. The system of claim 21, wherein the first distance exceeds the second distance by at least about 0.01 inch.

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23. The system of claim 22, wherein the first distance exceeds the second distance by at least about 0.05 inch.

24. The system of claim 23, wherein the first distance exceeds the second distance by at least about 0.1 inch.

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25. A system for air embossing a surface of an embossable fabric comprising:
a cylindrical stencil having an inner surface and a fabric-facing surface; and
an air lance including at least one nozzle thereon, the nozzle being constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric, with

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the nozzle being positioned so that at least a portion thereof is in contact with the inner surface of the stencil when the system is in operation.

26. The system of claim 25, wherein a portion of the air lance forming the nozzle that is in contact with the inner surface of the stencil applies a force to the inner surface of the stencil sufficient to reduce variations in a distance separating the embossable surface of the fabric and a portion of the fabric-facing surface of the stencil directly adjacent thereto.

27. The system of claim 26, wherein the portion of the air lance forming the nozzle that is in contact with the inner surface of the stencil applies a force to the inner surface of the stencil sufficient to essentially eliminate variations in a distance separating the embossable surface of the fabric and a portion of the fabric-facing surface of the stencil directly adjacent thereto.

28. The system of claim 25, wherein the air lance includes a nozzle forming component thereon, which nozzle forming component includes at least one orifice forming the at least one nozzle, at least a portion of which is in contact with the inner surface of the stencil.

29. The system of claim 26, wherein a maximum first distance separating the embossable surface of the fabric from a portion of the fabric facing surface of the stencil directly adjacent thereto, without the force applied to the stencil by the stencil stabilizer, exceeds a second distance separating the embossable surface of the fabric from the portion of the fabric facing surface of the stencil directly adjacent thereto when the system is configured for operation with the force applied to the stencil by the stencil stabilizer.

30. An air lance for directing air through a rotating stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

a conduit having at least one inlet opening therein;

at least one orifice forming at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation; and

at least one stencil stabilizer connected to and extending from the conduit, the stabilizer being constructed and positioned to contact an inner surface of the stencil during

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operation of the system, said contact creating a force on the inner surface that is sufficient to reduce variations in a distance separating the embossable surface of the fabric and a portion of a fabric-facing surface of the stencil directly adjacent thereto during rotation of the stencil, the stabilizer being further constructed and positioned so that at least a portion of the stencil stabilizer extends, when the stabilizer is not in contact with the inner surface, to a location separated from the longitudinal central axis of the conduit by a first distance, said first distance exceeding a second distance separating the nozzle from the longitudinal central axis of the conduit.

31. The air lance of claim 30, wherein the at least one stabilizer is constructed and positioned to contact the inner surface of the stencil during operation of the system, said contact creating a force on the inner surface that is sufficient to essentially eliminate variations in a distance separating the embossable surface of the fabric and a portion of the fabric-facing surface of the stencil directly adjacent thereto during rotation of the stencil.

32. The air lance of claim 30, wherein the stencil stabilizer comprises at least a portion of a nozzle forming component of the air lance, the nozzle forming component including the at least one orifice forming the at least one nozzle therein.

33. The air lance of claim 32, wherein the nozzle forming component comprises a first and a second separable component, with the first and second separable components being mounted on opposite sides of an outlet opening disposed in the conduit such that they are positioned adjacent to and separated from each other on the conduit so that the distance between adjacent facing surfaces of the first and second separable components defines a slit forming the nozzle.

34. The air lance of claim 33, wherein the stencil stabilizer comprises at least a portion of the first separable component and wherein a maximum distance separating the first separable component from the longitudinal central axis of the conduit exceeds a maximum distance separating the second separable component from the longitudinal central axis of the conduit.

35. The air lance of claim 34, wherein the first separable component is mounted on a side of the outlet opening that is upstream of the nozzle when the air lance is in operation.

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36. The air lance of claim 30, wherein a distance separating at least a portion of the at least one stencil stabilizer from the longitudinal central axis of the conduit is adjustable, when the stabilizer is positioned in contact with the inner surface of the stencil.

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37. In a system for air embossing an embossable fabric by directing a stream of air through at least one opening in a rotating cylindrical stencil and onto an embossable surface of the fabric, means for reducing variations in a distance separating the embossable surface of the fabric and a portion of a fabric-facing surface of the stencil directly adjacent thereto during rotation of the stencil.

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38. A method for stabilizing the rotation of a cylindrical stencil of an embossing system for air embossing a surface of an embossable fabric comprising:

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positioning a portion of a fabric facing surface of the stencil directly adjacent to the embossable surface of the fabric and at a first distance from the embossable surface of the fabric;

positioning at least a portion of at least one stencil stabilizer at least partially disposed within the cylindrical stencil so that the portion is in direct contact with a surface of the stencil; and

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rotating the stencil.

39. The method of claim 38, further comprising the steps of:

directing a stream of air onto the inner surface of the stencil;

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passing the stream of air through at least one opening in the stencil; and

impinging the stream of air onto the embossable surface of the fabric.

40. The method of claim 39, wherein during the directing step the stream of air is emitted from at least one nozzle of an air lance that is at least partially disposed within the stencil, the nozzle being positioned in contact with the inner surface of the stencil.

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41. The method of claim 40, wherein during the impinging step a distance separating the embossable surface of the fabric and a portion of a fabric facing surface of the stencil that is

positioned directly adjacent thereto is maintained essentially constant during rotation of the stencil.

42. A method for stabilizing the rotation of a cylindrical stencil of an embossing system
5 for air embossing a surface of an embossable fabric comprising:

applying a force to the stencil sufficient to reduce variations in a distance separating
the embossable surface of the fabric and a portion of a fabric-facing surface of the stencil
directly adjacent thereto during rotation of the stencil; and
rotating the stencil.

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43. The method of claim 42, wherein the applying step comprises the steps of:

positioning a portion of the fabric-facing surface of the stencil at a first distance from
the embossable surface of the fabric;

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positioning at least a portion of at least one stencil stabilizer at least partially disposed
within the cylindrical stencil so that the portion is in direct contact with an inner surface of
the stencil.

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44. The method of claim 42, wherein the force applied to the stencil during the applying
step is sufficient to essentially eliminate variations in the distance separating the embossable
surface of the fabric and the portion of the fabric-facing surface of the stencil directly
adjacent thereto during rotation of the stencil.

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45. A system for air embossing a fabric comprising:
a cylindrical stencil with a plurality of openings formed therein;
means for rotating the stencil about a rotational axis that is parallel to or co-linear
with the longitudinal axis of the stencil;

means for supporting a fabric having an embossable surface for movement in a
direction forming a non-zero angle with respect to the longitudinal axis of said stencil;

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means for directing air from within the cylindrical stencil through the openings and
towards the embossable surface; and

at least one stencil stabilizer constructed and positioned to engage an inner surface of
the cylindrical stencil to reduce variations in a distance separating the means for supporting

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the fabric and a portion of an outer surface of the stencil directly adjacent to the embossable surface of the fabric as the stencil rotates.

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